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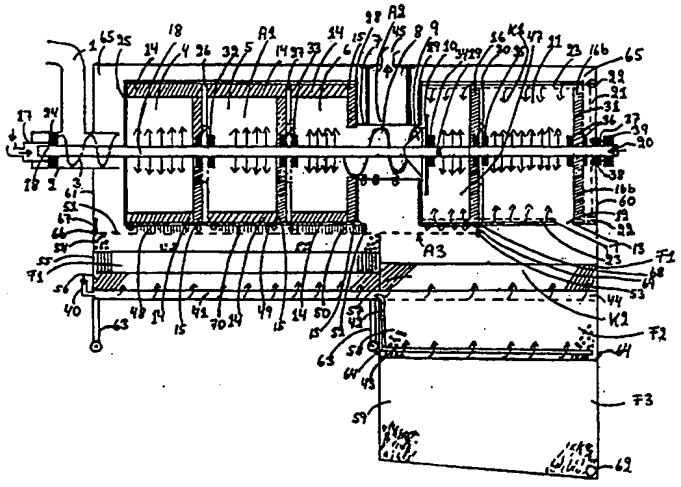

(57) Abstract

Method of continuous treatment and purification of biologically decomposable waste and liquid by a step-by-step dewatering of the said material, by means of sedimentation in various rotating chambers (4-6) and being drained with a simultaneous oxygenization via a rotating driveshaft (shaft-pipe, 8) by means of a rotating perforated cylinder (A1, A2) or a perforated cylinder. There is step-by-step drainage in various dewatering units (A1, A2), which are separated from each other, before the transfer of dewatered dry matter via a perforated pipe with an envelope (7) or a perforated cylinder to a subsequent dry compositing (K1). The liquid is now being filtrated step-by-step by filter layers (54-59) which are integrated in filter units (F1, F2, F3), and that there is oxygenization of filter layers (54, 55, 56, 57, 58) via an oxygenization unit (41, 43, 44). The invention also includes an apparatus for the said purpose.

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Cylindrical sieving and composting device and a method using the device.

Description :

The present invention relates to :

An apparatus for the purpose of rendering efficiency and automation in the treatment of and purification of biologically decomposable waste in liquid, such as waste water, by a continous dewatering,water purification and composting process in the same construction of apparatus.

The background of the invention:

The present invention relates to an apparatus which by integrating dewatering/sludge separation,the purification of liquid and a composting process of the solid separated fraction such as the sludge from waste water provides a system of purification and recycling, say applicable to the waste water of a one family house, block of flats or cluster of houses (terraced houses, ecological building, small villages etc.) where a common waste water pipe is laid to the above described apparatus for the treatment and purification of waste water before being infiltrated, resorbed or being led directly to a recipient.

The outflowing water from the apparatus is free from heavy metals, nutrients, virus, pathogenic organisms, BOD/TOD, bacteria etc., and therefore can be infiltrated without a slurry (sludge) separator, distribution pipes, distribution tank and subsoil filter.

The system can also be used for other purposes of purification where organic matter is dissolved in a liquid phase and where

you as well recycle the biological substance from the obtained compost fraction.

The said described apparatus promotes recycling of nutrients in for example waste water (N,P,K etc) by obtaining a compost fraction from waste water sludge etc., and purifying the outflowing water effectively by a gradual filtration through specifically arranged and designed steps of filters for the purification process.
Dewatering occurs in the said apparatus by a step by step adjusted dewatering device according to the particle size of the solid fraction.

Thanks to the construction of the apparatus and the process there it can be installed in the subsoil, basement, built into a separate building or being dug down into the ground. The final step of filtration can be installed into the ground at a lower level than the apparatus itself.

The private waste water systems of Sweden amount to approximately 400.000-500.000 with only slurry separators where the reduction of nutrients only reaches roughly 10%. A large number of drain pipes require restoration, even those of existing buildings in towns and rural areas where, like the private waste water systems, local solutions can be made.

With a local solution close to the source more conscious consumers and producers of waste will be the result of it all, and thereby more effective, cleaner, renewed and recycled waste fractions for the individual and for society.

As for the local society with an option to make use of human urine, especially concerning the collection, storing and transportation to the consumer a separation of the urine and preferably of the grey water (from bathing, shower, washing

etc.,) can be carried through in order for the said apparatus to purify toilet waste water only.

Technical effects of the apparatus on society, enviroment and individual:

1.The process is not disturbed by surface water and makes a local treatment of surface water possible in for example sub surface filters, wells, ponds, wetlands etc.

2.The process is not affected by fluctuations of the temperature (seasons, day and night).

3.The process is not affected by changes of waste water flow during 24 hours thanks to the separation into process chambers where for example dewatering takes place in the first chamber (4) at low rates of flow and in the other chambers (5-6) at higher rates of flow. Some degree of liquid composting also takes place in the process chambers (4-6) during hours of a low rate of flow.

4.A good sanitation owing to the liquid composting process and to the dry composting process during a relatively extended retention time of the solids with high temperatures (50-60 degrees Celsius). These effects of sanitation are more difficult to obtain in liquid composting only, three-compartment septic tanks and open settling basins of purifying plants during seasonal changes.

5.Intermittent flows of waste water also provide fluctuating access of nutrients for the microorganisms. These circumstances affect a large number of bacteria populations so that they during a certain period of time , when lacking of for example phosphorus , are capable of building into the cell a larger

amount of phosphorus than normally; that is when larger supplies are available at such occasion as the fluctuating flows of household waste water.
In the biological film generated in the filters (54,58) with so called trickling filter material as well as in the micropores, phosphorus is stored so that the population of bacteria can multiply even during low flows of nutritious waste water. The similar effects are likely to take place in the rest of the filters.
6.With a filter structure out of biological material (filter 57 etc.) also a decomposition and sorption of nitrogen, phosphorus etc. will occur.
Such filters may be recycled to the composting phase of the apparatus.

7.Filters with a specific construction adjusted for specific substances, such as heavy metals can be made to be inhabited by heavy metal eating microorganisms or made to adsorbe the said substance physically or chemically. In the latter case the filter is constructed so that it can be safely dumped.

8. By having a filtration technique adjusted to different substances/bacteria the specific substance is made to be adsorbed to the filter or decomposed by bacteria in order for these substances to be renewed or safely disposed of.

9.The processes can effectively be checked up on and supervised (temperature, filtration capacity, sludge separation capacity etc.).

10. The processes are selfcontained, i.e. minor pollution load upon air, water and ground from pathogenic organisms, virus, bacteria, heavy metals, nutrients etc.
The apparatus is capable, by means of its different devices of process enclosed in a compact envelope (devices of dewatering,

composting, filtration etc.), easily to be equipped with a heat exchanging of the exhaust air/recirculated air heat and be equipped with a biological filter in the exhaust air to minimize odours and the spreading of air-born microorganisms.

11. A system adjusted to decentralized, small scale waste water treatment, where the structure of the ground, topography, level of ground water, area available for infiltration etc. are not fitted for other conventional solutions, like infiltration into ground, sandfilters, reed infiltration beds etc.

12. A system where three-compartment septic tanks,infiltration pipes,distribution tank,filtermaterial (sand,pebbles etc.) will not be needed in order to obtain an acceptable level of water purification and an acceptable status of the compost fraction.

13. A method of treating sludge which reduces the contents of heavy metals, pathogenic organisms, parasitic ova, maggots, plant diseases and which encreases the contents of micro and macro nutrients of the final compost fraction. These facts make household waste water sludge easier to be found a market for and to be used within the decentralized society and to achieve an enhanced recirculation of nutrients and humic substances in society as a whole.

14. A reduced transport of sludge to purifying plants; the processes of which are spoiled by intermittent supplies of sludge and a reduced number of vehicles with diesel engines for the suction of sludge tanks and three-compartment septic tanks and thereby a reduced necessity to enlarge and alter the structure of the purifying plant in order to handle this.

The effects of the technical processes of the apparatus:

1. High temperatures of the composting phase (liquid and dry composting) promotes the sanitation and the microbiological activity.

2. Water soluble metal ions move along with the dewatered fraction to the filter units to be decomposed/sorbed.

3. By a gradual dewatering, adjusted to the size of the solid fraction dissolved in the liquid, an effective separation of the sludge is done. In the different chambers sedimentation to a certain degree is achieved and thereafter a dewatering through the perforated cylinder (A1) and by means of the feeding screw with a cone (unit A2) and by means of a shaking plate (51). In the latter the solid and the liquid fraction are separated by sedimentation,separation in a perforated plate and by shaking and the sludge is moved forward to the filter unit (F1-57)

4. In the filter units with so called trickling filter material (54,58) the microorganisms are made to reduce the biological substance (the so called; BOD/TOC).
The consequence of this will be that in the nextcoming filter step the water has become more or less free from particles which enhances the possibilities of separation and purification of the water from other substances; for example heavy metals in these filtersteps.

5. With less BOD/TOC the possibilities of survival of the non desireable microorganisms (parasitic ova, bacteria, plant diseases etc.) are reduced. In particular virus living in water can not have an access to a host to sponge on.

6. The filter units can with the said construction of apparatus easily design filter and change the filter material in order to

obtain different effects of purification of the outflowing water.
Filter unit (F1) is removed torwards the front (at 61). Filter unit (F2) is removed torwards the back (at 60) and filter unit (F3) is removed by a lifting of the apparatus by means of adjustable legs. The latter (F3) filter step is a final purification step which can be equipped with varying filter material according to the purification required. This filter step can be installed into ground or at a lower level than the rest of the apparatus.

7. By separating the units of dewatering and composting (dry composting) a more appropiate content of dry matter is obtained, a certain degree of heat is stored in the solid fraction and more undisturbed enviroment for the microorganisms and their biological processes (flows of water do not interrupt).
Fluctuations of the Ph-value do not disturb the process. An effective oxygenation of both the composting and the dewatering/liquid composting takes place, oxygen is dissolved in the water and is carried along to, say, the filter with the trickling filter media (54) and an appropiate stirring takes place in unit (K1) in the two process chambers.

8. Oxygenation with two separate systems can easily be adjusted to the levels required in the processes. Favourably two fans can be used and when required being regulated as to the number of revolutions and flow.

9. The feeding screw at the inlet of, say, waste water (3) render the feeding at any possible lower rates of flow more efficiency and when using a water flushing toilet a so called low flushing toilet can easily be installed supported by the feeding and pumping functions of the screw. It also assists during major fluctuations of flow during 24 hours.

10. The screw in the dewatering unit (A2) transports the solid fraction up against the cone (9) which momentarily make a stop for the sludge against the perforated pipe with an envelope (7) and effectively dewaters the solid fraction. In this unit (A2) the pitch of the screw and size of the screw and shape of the cone are adjustable according to the specific requirement of dewatering. Owing to this function the content of dry matter of the substance to be composed in (K1) is possible to optimize/adjust.

11. The longitudinal slits (14) in unit (A1) collect the dewatered fraction in between. The number of slits can vary according to the requirements (for example 2-4). These slits also effectively convey the water along the whole of the perforated area of the cylinder (the size of which is relatively large owing to the area of the geometry of the cylinder: The area= 2* π * the radius* the length of the cylinder) and transports the separated solid fraction forwards by the slight inclination of the apparatus - by an elevation of the front legs and by letting the water flow in the same direction bringing the solid fraction up against the shovels (15) which effectively feeds the fraction through the inlet of the reinforcement disc (26-28) and likewise (35) in unit (K1). The said shovels in unit (15) in unit (A1) and 16/16b in unit (K1) also has a collecting function of the concentrated sludge.

12. The final compost has undergone a sanitation and initial mineralization in unit (K1). Likewise is valid for the solid fraction from the dewatering of the shaking plate (51) which is put into the filter (57). The compost fraction is evacuated from the apparatus in pipe (13) in order to obtain further maturity in a separate container etc. and will not constitute a sanitary hazard nor attract rats etc.

This system brings about the fact that there is no need of supervising the running of the apparatus at frequent intervals since the compost is collected in an external container in a safe way and is possible to supervise there.

13. By the effects of the above described functions/technical devices it is evident that this apparatus makes an effective treatment and purification of for example waste water in an automized and continuous process with few interruptions of process / a process easy to supervise and control.

14. The construction and integration of the dewatering units, filter units and composting units and the fact that they function together in a continous and automatic running of the apparatus constitutes an optimization of the effects of the said invention in a technical and social perspective comparing to the state of the art within this field.

15. The said apparatus achieves its technical effect and technical invention by the above described integration and adjustment of a mechanical and microbiological reduction of BOD/TOC to a desireable necessity of a reduced content of particles in the water phase in order to optimize the killing of virus and bacteria and make a selective purification in the subsequent steps of filter from specific substances; such as heavy metals and in order for each step of filter to achieve an optimal separation of specific substances like bacteria. The mechanical dewatering process (by sedimentation, sieving, shaking etc) makes up the conditions of the filter units to be able to optimize their functions (for example filter 54-57) during which the smaller particles are decomposed as to their size by the microorganisms.
The mechanical separation makes it possible for the composting phase to function optimally (higher content of dry materia, reduced volymes etc) and for the microorganisms in the process

to obtain optimal conditions (an atomization also takes place in the screw (8) and in the cone (9) because of a grating effect there; This unit may also function as a grinding device, the effect of which on the other hand reduces the volume of this fraction and increases the flow speed of for example waste water through the apparatus / the capacity of treatment of the apparatus increases.

Description of the process.

At the treatment of, say, waste water (faeces, flush water and possible urine and grey water) the water flows into the pipe (1) to be led through and pumped through a pipe with an envelope (2) by a screw (3) to chamber (4). In this chamber the sewage water is distributed across the whole area by slits (14) that extends longitudinally in the cylinder.
A dewatering process occurs through the perforated cylinder all across the whole of its area down to a shaking plate (51). At larger volumes of water than can be contained in the chamber (4) the water flows over to the chamber (5). By a centered position of the reinforcement discs (26-28) a sedimentation takes place before the flowing over and meanwhile a dewatering through the perforated cylinder. The slits (14) also collect the dewatered fraction against its edges during the slow rotation of the cylinder (continuous running of the apparatus). Owing to the inclination of the apparatus (elevation of the front legs) and the direction of the flows (water), the solid fraction is being transported forwards to the inlets of the discs (26-28).
At these inlets there are shovels (15) which collect and bring the sludge through the inlets; by the rotation of the cylinder and the direction of the flowing water and the inclination of the cylinder.

The shovels at the unit (A2) - 28 - before the screw (8) etc feeds the sludge to the unit (A2) for further dewatering. During this state of the process larger particles/biological matter remain in the unit (A1) whereas smaller particles go with the water down to the shaking plate (51).

Shaking plate (51) consists of a perforated plate with means of sieving the smaller particels dissolved in water (drawing 1-4). A natural drainage of water now takes place through this perforated plate so that separated sludge remains on the surface of the plate.

Brushes (48-50) on the outside of the cylinder bring the sludge outwardly towards the edges of the shaking plate. By reversing the electric motor the cylinder is made to rotate in two directions, which brings about the sludge to be brought towards both the edges of the shaking plate.

The said plate is fastened to a jointed shaft (66) on the front of the external envelope (61) and to a means of attachment (67). The plate also has a jointed shaft in the longitudinal direction (71). The plate is furthermore fastened to an elastic/springy means of attachment (53) at the sides of the insulating envelope (65). The plate can thus move in its midpart, longitudinally, by elevation-lowering (joint-71-); elevation-lowering across the whole length (joint-66- and elastic/springy means of attachment) so that the sludge is transported outwardly - forward - towards a flexible plate (69). Hereby the bending of the plate (69) at the touch by peg (68) in the cylinder the sludge is made to fall down on filter (57).

By rotation of the cylinder the peg (68) touches the plate (69) at constant intervals. The number of pegs and the distance in between determines the frequency of the removal of separated sludge to filter (57).

The brushes (48-50) also make the shaking plate (51) to be bent downwards-upwards so that the water and sludge move across the

whole of the plate out towards the edges then to be transported forwards by means of the described device.
A flexible plate (52) is made to let the sludge through intermittently by brush (50) bending it. It also functions as a stop and collecting plate of the water. Plate (70) functions in the same manner as plate (52).
On the internal side of the front (61) you find a distributing pipe (72) with nozzles for the flushing and cleaning of shaking plate (51) and for the forward transportation of separated sludge. This flushing can be controlled mechanically or electronically.
The separated solid fraction is moved by the shovels (15) in the chamber (6) into the dewatering unit (A2) with a screw (8), pipe with an envelope (7) and a cone (9). The rotation of the screw brings the matter out towards the edges and forward. The shape of the cone (9) makes the sludge to be pressed further against the internal side of the pipe with an envelope (7). Since this pipe is perforated the sludge is further dewatered. Passing the top of the cone the matter is further pressed against the inner walls of the pipe (7) so that the dewatering is accentuated.
The liquid phase passes down to the shaking plate (51) obtaining a further dewatering there.
The liquid phase is now pressed against the plate (10) for further dewatering. Here the liquid flows down to the chamber (47) which has a perforation of its cylinder walls so that superfluous water is drained out towards the filter (57).
The solid fraction undergoes a composting phase in the said chamber (47) and in the chamber (11). When the matter reaches the hatch (12) it is evacuated through pipe (13) to an external unit of storage.
Plate (10) also makes the dewatering and disposal of the solid fraction to be carried through within a limited area where an increasing number of holes can be made for a dewatering purpose.

Filter (54,58) have so called trickling filter material with a large internal and external area for the microbiological decomposing of TOC/BOD. Here you find a liquid phase with minor particles only, that promote the work of the microorganisms in the micropores and on the surface of the material. There are water and nutrients for them here. The oxygen supply takes place beneath the filters in unit (41), the air of which is blown in pipe (40). Air is then led to unit (44) for the oxygen supply of filter (57) and to unit (43) for the oxygen supply of filter (58).

By means of a pipe in the center of the apparatus (45) the exhaust air is ventilated in order for an effective ventilation of carbon dioxide, vapour and other gases to be done.

Beneath filter (57) there is a perforated plate for the distribution of water from unit (41) - The collecting and oxygen supply during the water phase takes place in the same location of installation. The distance between filter (57) and the plate; the space required for the flow of water at (44) is adjusted to the volume desired to pass there.

The filter unit (59) is removable by the elevation of the apparatus by means of adjustable wheels and by moving the apparatus in any direction. Via (64) the unit is removed. This filter constitutes a final step of purification and may be supplied with varying filter material according to the specific requirements of purification and be installed into the basement, the ground etc or removed completely.

The oxygen supply of the dewatering units (A1 and A2) is done from the direction of the front of the apparatus (61) towards unit (A2) and has a stop in the shaft/ventilation duct (18) at (19).

The air is pressed out from the shaft (18) into each chamber (4-6) and into unit (A2) through holes in the pipe (18). The excess pressure makes the water not to be pressed into the pipe. The feed pipe (17) is connected to a fan, possible to regulate as to revolutions and flows.

Unit (K1) for the composting process has its oxygen supply from the back of the apparatus (60) via a pipe (18) with a stop at (19). Here as well the oxygen supply is done by air pressed through holes in the shaft/duct (18). A fan presses the air and when required it can be regulated for the adjustment of the airflow to the process.
Further oxygen supply takes place through the ducts (23) with the same fan. Nozzles blow air into the ducts (23) that extend against the periphery of the cylinder.
The bearing (24) and the bearing (38) are devices for the rotation of the shaft (18). The bearings (32,33,35,36) lock the cylinder to the shaft (18) and are integrated in the plates (26,27,30,31).
The bearing (34) attaches the plate (10) to the shaft (18) and may rotate with it or being attached to the pipe with an envelope (7) and thus being journalled in a bearing against the shaft (18).
The pipe with an envelope (7) is attached to the roof of the envelope of the apparatus at (45).

Alternative design of the invention: (Fig. 5)

The dewatering unit A2 can be constructed with a perforated cylinder (73), which is removeable and changeable and connects the dewatering unit (A1) and the composting unit (K1).
By the rotation of the shaft (18) the perforated cylinder (73) is also caused to rotate, during which rotation a dewatering will occur through the holes, forming part of the wall of the cylinder.
The solid fraction is transported by the inclination of the entire device towards the shovels (74) and a sealing plate (29), in the said design performed as a terminal plate of the unit (K1-cylinder-) with a center hole.
The shovels (74) collect and feed the solid fraction forward through this center hole for a further dewatering against the

plate (10) and dosing with the same plate (10) to the composting unit (K1-chamber 47-).
The further process and process devices are identical with the first design.

By the said design the perforated cylinder can be changed according to the demand of dewatering (the type of material: the dry substance, the viscosity etc.). That is by a variation of the number of the holes and diameter of the holes of the perforated cylinder a varying degree of dewatering is achieved.

Technical data.

1. Feed pipe - black water/grey water etc.
2. Pipe with an envelope - Screw/feed pipe to cylinder A1 (dewatering).
3. Feed and pumping screw.
4. Dewatering chamber (part of unit A1: Dewatering; perforated).
5. Dewatering chamber (part of unit A1: Dewatering; perforated).
6. Dewatering chamber (part of unit A1: Dewatering; perforated).
7. Pipe with an envelope for screw-8- and cone-9-(dewatering, A2).
8. Feeding-, pumping and dewatering screw.
9. Dewatering cone.
10. Plate for the dewatering and dosing feeder of solid fraction to K1 (47).
11. Chamber for the composting of the solid fraction (part of K1).
12. Hatch for the evacuation of compost to pipe -13-.
13. Evacuation pipe for the compost fraction.
14. Slits (extending longitudinally in cylinder A1 and chambers 4-6 for the collection, distribution and feeding of the solid

fraction and for the distribution of the water fraction across the whole of the cylinder.
15. Shovels for the collection and feeding of the solid fraction in A1.
16. Shovels for the collection and feeding of the solid fraction in K1 with shovel 16b integrated in suspension plate for cylinder K1 and shaft (18).
17. Feed pipe for the air supply of unit A1 and A2 (up to stop-19-) and for the air supply of the dewatering-and sludge separating units A1,A2.
8. Shaft pipe for the suspension of unit A1,A2,K1 and screw -3- and air supply to unit A1 and A2.
19. Stop of air supply.
20. Shaft pipe -18- for the air supply to unit K1 (composting).
21. Air-distributing ring with nozzles for the oxygenation of the compost fraction of unit K1 via ducts -23-.
22. Nozzles of the air-distributing ring -21- positioned across the whole of the ring-21-.
23. Ducts (longitudinally extended against the inner periphery of the cylinder) for the oxygenation of the compost process in unit K1 ending in plate -31-.
24. Bearing and suspension of the shaft -18-.
25. Sealing plate against the pipe with an envelope -2- for the chamber -4- in A1.
26. Reinforcement disc in cylinder -A1- and supporting device of the bearing -32- for the locking and suspension against the shaft -18- formed as a plate with reinforcement arms and openings for the feeding between chambers 4-6.
27. Reinforcement disc in cylinder -A1- and supporting device or the bearing -33- for the locking and suspension against the shaft -18- formed as a plate etc. (as follows according to the item above; 26).
28. Sealing plate against the pipe with an envelope -7- as part of unit A1.

29. Sealing plate against the pipe with an envelope -7- as part of unit K1.
30. Reinforcement disc in cylinder K1 and supporting device of the bearing -35- for the locking and suspension etc (according to item above; 26... for the feeding of the compost fraction to chamber -11-.
31. Reinforcement disc in cylinder K1 and supporting device of the bearing -36- for the locking and suspension of cylinder -K1- against shaft -8- formed as a plate with reinforcement arms and ducts -23- for the oxygenation of K1.
32. Bearing for the locking of cylinder A1 and suspension of shaft -18- against cylinder A1 as part of plate -26-.
33. Bearing for the locking and suspension etc (according to item -32- as part of plate -27-.
34. Bearing for the attachment of plate -10 rotating with shaft -18-.
35. Bearing for the locking and suspension etc (according to item -32- as part of plate -30-.
36. Bearing for the locking and suspension (according to item 32) as part of plate -31-. Plate -31- is integrated with shovels -16-.

(Drawings 1,2,3,4: as follows)

37. Spacer rings between cylinder -K1- and the back of the apparatus -60-.
38. Bearing and suspension of shaft -18-.
39. Pulley or gear wheel for the transmission of power from the motor to the shaft -18-.
40. Inlet pipe of air for the oxygenation unit -41,43 and 44 -
41. Oxygenation unit for the filter unit F1 (54-56).
42. Air-distributing pipe for the oxygenation unit -43-.
43. Oxygenation unit for the filter unit -F2-.
44. Oxygenation unit for the filter unit -F1-.

45. Exhaust pipe for the exhaust ventilation of the apparatus.
46. Perforated dewatering pipe in unit A1 for further dewatering in unit A3 (also note -7-).
47. Chamber for the composting process as part of unit K1; Perforated.
48. Brush for the removal of the separated solid fraction in unit A3 and starting of the shaking of shake plate -51- for the forward transportation of the separated sludge to a flexible plate -53- for the discharging to filter F1 and a composting process.
49. Brushes etc (according to item 48).
50. Brushes etc (according to item 48).
51. Shaking plate for the dewatering and collection and transportation of sludge to the composting process in filter -F1-.
52. Flexible plate for the collection of the solid fraction.
53. Flexible plate for the disposal of the solid fraction to F1 and suspension of shake plate -51-. With an elastic/springy means of attachment -53-.
54. Filter unit for further decomposition and reduction of TOC (solid fraction: as total amount of carbon) with a so called trickling filter material, not decomposable and with an enlarged area- internal/external-. Integrated in the filter unit F1; removeable for exchange forwards towards the front of the apparatus-at 61-.
55. Filter unit for the collection and purification of the water fraction from, say, heavy metals, nutrients etc. Also constitutes a part of unit F1. Removable in the same manner as item 54, above.
56. Filter unit for the collection and purification of water etc. (according to item 55). Also removable according to item -54-.
57. Filter unit for the purification of water from the dewatering unit A1,A2 and A3 and possibly water from -51- from TOC/BOD and other specific substances; such as nutrients and

for the purification and composting of sludge or similar biological material from -51-. Constitutes a part of unit F1 and is removable forwards (at 61)

58. Filter unit with so called trickling filter material for a final step of purification with microorganisms within the filter material (see also item 54). Constituting a part of unit F2 and removable backwards at -60-.

59. Removable filter for a final step of purification of the water fraction before the evacuation of purified water via pipe -62-. Can be installed into ground, basement etc. Removable by the elevation of wheel/legs -63- by moving the apparatus, say, forwards. The filter is removed at -64-.

60. Back of the apparatus; protecting envelope of the apparatus.

61. Front of the apparatus; protecting envelope of the apparatus.

62. Evacuation pipe of the purified water.

63. Adjustable legs/legs of support; to be elevated for the removal of filter -59-.

64. Projecting device for the installation of the removable filter -59- to filter unit F2.

65. Side part of the apparatus; protecting envelope.

66. Jointed shaft in shaking plate -51- attached to the front at -61-.

67. Means of attachment of the shaking plate -51- and shaft -66- at the front -61- and an edge for the embodying of the dewatering unit A3.

68. Peg on the cylinder for the shaking movements of the shake plate -51- and downwards bending of a flexible plate -69- that is attached with an elastic/ springy means of attachment to the side of the apparatus at -65- and for the disposal of the solid fraction to filter -57-(F1).

69. Flexible plate for the disposal of the solid fraction to filter -57-.

70. Flexible plate for the collection of the solid fraction.

71. Jointed shaft in the shake plate extending from the means of attachment -67- to a flexible plate -69-.
72. Distribution pipe with nozzles for the flushing of shake plate -51- and for the transportation forwards to plate -69- for the disposal of the solid fraction; arranged at the means of attachment -67-.
73. Perforated cylinder-removeable-and constituting a connecting unit between unit A1 and unit K1.
In itself constituting an alternative design of the dewatering unit A2, where the number of holes and diameter of holes can be varied according to the actual needs.(fig 5)
74. Shovels for the collection and forward feeding of the solid fraction from the dewatering unit A2 to the composting unit K1. In itself constituting shovels of the alternative design. (fig. 5).

C l a i m s

1. A method of continuous treatment and purification of biologically decomposable waste and liquid by a step-by-step dewatering of the said material, by means of sedimentation in various rotating chambers (4-6) and being drained with a simultaneous oxygenization via a rotating driveshaft (shaft-pipe , 8), by means of a rotating perforated cylinder (A1,A2) or a perforated cylinder (73), **c h a r a c t e r i z e d** by a step-by-step drainage in various dewatering units (A1,A2), which are separated from each other, before the transfer of dewatered dry matter via a perforated pipe with an envelope (7) or a perforated cylinder (73) to a subsequent dry composting (K1), the liquid now being filtrated step-by-step by filter layers (54-59) which are integrated in filter units (F1,F2,F3), and that there is oxygenization of filter layers (54,55,56,57,58) via an oxygenization unit (41,43,44).

2. A method according to claim 1, **c h a r a c t e r i z e d** by a dewatering by means of drainage and sedimentation by the shaking of a plate (51) by means of a peg (68) and brushes (48-50) attached to the cylinder causing a shaking of the plate (51) by means of jointed shafts (66,71) and elastic springy means of attachment (53) when the cylinder is being rotated momentary.

3. A method according to any one of the claims 1-2, **c h a r a c t e r i z e d** by causing further dewatering of the forward feeded solid waste in the pipe with an envelope (7) or in the perforated cylinder (73) by means of a screw (8) and a cone (9) in the pipe (7,73).

4. A method according to claim 3, **c h a r a c t e r i z e d** by a final adjustment of the dry matter content of the solid fraction by pressing the said material between the cone (9) and a plate (10) and between a plate (10) and a sealing (29).

5. A method according to any one of the claims mentioned above, **c h a r a c t e r i z e d** by giving the solid fraction an automatic and continous flow forward in the cylinder (A1,A2) with an automatic discharge through a pipe (13) and that the liquid fraction automatically flows continously through the filters (54-59) finally automatically and continously being evacuated through a pipe (62).

6. A method according to any one of the claims mentioned above, **c h a r a c t e r i z e d** by the filters (54-59) being placed underneath respective unit (A1-A3;K1) for the purpose of receiving liquid with a continously diminishing number of particles dissolved in it, from one unit to another.

7. A device for a continous treatment and purification of biologically decomposable waste and liquid by a step-by-step dewatering by means of sedimentation in various rotating chambers (4-6) and being drained with a simultaneous oxygenization via a rotating driveshaft (shaft pipe, 8), by means of a rotating perforated cylinder (A1,A2;73) according to any one of the claims mentioned above, **c h a r a c t e r - i z e d** by the rotating driveshaft (8) extending through various dewatering units (A1,A2) which are separated from each other, a rotating dry composting unit (K1) and a perforated pipe with an envelope (7) or a perforated cylinder (73) extending between the said units, by filter layers (54-59) integrated in filter units (F1,F2,F3) and by the oxygenization

units (41,43,44) designed for oxygenization leading to said units (F1,F2,F3).

8. A device according to claim 7, **characterized** by a shaft (18) journalled in bearings attached to the back and front (60,61) of a tight envelope of the apparatus, arranged partly for a separate oxygenization with an amount of oxygen adjusted to the dry matter content of the dewatering and wet composting unit (A1) with the process chambers (4-6) and the dewatering unit (A2) through a certain number of aeration holes in the said shaft (18) with a feed of air from a feed pipe (17), closely attached to a bearing (24) and with a stop of air supply (19) in the shaft (18), partly for the purpose of a separately arranged oxygenization with an amount of oxygen adjusted to the dry matter content of the dry composting unit (K1) with the process chambers (47,11) through aeration holes in the shaft (18) with a feed of air from a pipe (20) and for an adjusted oxygen supply from the nozzles (22) in an air distributing ring (21) via the ducts (23) to the process chambers (47,11), partly for the suspension and locking against the shaft (18) of the dewatering and wet composting unit (A1) with the process chambers (4-6) and locking of the dewatering unit (A2) with a feeeding, pumping and dewatering screw (8) and a dewatering cone (9) and for the suspension and locking against the shaft (18) of the dry composting unit (K1) with the process chambers (47,11) for the purpose of an encreasing dry matter content adjusted to the composting process of each chamber and for the locking of the bearing (34) with a dewatering and dosing feeder plate (10) against the shaft (18) and partly for the units (A1,A2 and K1) which with the bearings (32-36) are locked and suspended against the shaft (18) and which said units consist of the perforated cylinders (A1,K1) with an adjusted number of holes and adjusted diameter of the holes for a dewatering purpose, by a suspended and locked feeding and pumping screw

(8) and a dewatering cone (9) in a perforated pipe with an envelope (7), against the shaft (18), by a suspended and locked feeding and pumping screw (3), in a pipe with an envelope (2), against the shaft (18) and by a suspended and locked stop plate (10), against the shaft (18), for the purpose of dewatering of the waste and the dosing of the solid fraction to unit (K1), which units (A1,A2;8,9;K1-10 and 3) are arranged to rotate by the rotation of the shaft (18) by means of the transmission of power from an engine to the shaft (18).

9. A device according to claim 6, **c h a r a c t e r i z e d** by the slits (14) in a unit (A1) for the collection, distribution and feeding of the solid fraction and spreading of the liquid fraction all across the whole interior area of the cylinder by the rotation of the shaft (18) and by the process chambers (11,47) in a cylinder (K1) which by the rotation of the shaft (18) causes superfluous liquid to be spread across the interior area of the cylinder (K1) and liquid to be accumulated in the perforated ducts (23) in order to flow down to a shaking plate (51) through the perforation of the cylinder in the process chamber (47).

10. A device according to any of the claims 7-9, **c h a r a c t e r i z e d** by a filter in the filter layer (54) consisting of a not biologically decomposable "trickling filter" (for example in varying plastic moulded shapes: wheel shape, spherical shape etc.) with a large interior and exterior surface area for the purpose of purifying liquid and the decomposition of biological substance in the liquid, filter layer (55) consisting of biological or synthetical material for the purpose of the collection of and the purification of the liquid fraction from specific components; for example heavy metals, nutrients etc., filter layer (56) consisting of biological or synthetical material for the purpose of collection of and purification of the liquid fraction from

specific components and for the transportation of liquid and biological substance dissolved in liquid to the filter layer (58), filter layer (57) consisting of biologically decomposable filter material for the purpose of the purification of liquid from the dewatering units (A1,A2,A3) via a shaking plate (51) and for the storing of the solid fraction in the filter material, designed for a composting process, filter layer (58) consisting of not biologically decomposable "trickling filter" (plastic moulded shapes etc, with a large interior and exterior surface area for the collection of and purification of biological substance dissolved in liquid in order for the purified liquid to be finally evacuated through the evacuation pipe (62) and a removeable filter (59) for a final purification of the liquid fraction.

11. A device according to any one of the claims 7-10, **c h a r a c t e r i z e d** by an oxygenization unit (41) feeding oxygen to the filter layers (54,55,56) via the inlet pipe (40) and the space (41) (of the oxygenization unit -41-), by an oxygenization unit (43) feeding oxygen to the filter layer (58) via a pipe (40), space (41), air distributing pipe (42) and space (43) and by an oxygenization unit (44) feeding oxygen to the filter layer (57) via a pipe (40), space (41) and space (44).

12. A device according to any one of the claims 7-11, **c h a r a c t e r i z e d** by the attachment of a perforated shaking plate (51) to an articulated shaft (66,71) and attachment to an elastic and springy attachment (53), which said plate is caused to shake at the rotation of the shaft pipe (18) by the contact between a peg (68) on the cylinder and a flexible plate (69) and by the contact between the brushes (48-50) and a flexible plate (52,70), for the purpose of collecting liquid and particles dissolved in liquid at plate (52,53,69,70), of dewatering liquid to a filter unit (54) and

for the purpose of conveying the solid fraction to a filter unit (57) for the purification of the liquid and the composting of the solid fraction.

13. A device according to any one of the claims 7-12, **c h a r a c t e r i z e d** by the dividing up of the oxygenization of the dewatering unit, composting unit and filter unit into three separate systems with the effect that the oxygenization will be easier to regulate with the help of three smaller fans all according to the oxygen demand of each unit and with the effect that the great oxygen demand of the dewatering unit for the wet composting and oxygenization of the liquid for the functions of the filters will not cause any disturbance to the oxygenization of the composting unit (K1), in order for air for the dewatering unit to be blown in via pipes (17) and shaft/duct (18) from the direction of the front side of the apparatus (61), air for the filter units is blown in via the inlet pipe (40) to the units (41,44), pipe (42) to the unit (43) for the oxygenization of the filters, air for the composting unit is blown in via pipes (18/20) from the direction of the back side of the apparatus (60) and the nozzles (22) and the ducts (23), from the same direction, for the oxygenization of the composting process.

14. A device according to any one of the claims 7-13, **c h a r a c t e r i z e d** by having adjustable legs (63) so that the filter (59) can be removed by the moving of the apparatus and the filter (59) is removed at the projecting device (64) and a varying inclination of the device can be achieved and thereby a varying speed of the forward feeding of the liquid and the solid fraction and that the filter unit (F 1:54-57) can be removed forward through the front side (61), a filter unit (F2) can be removed, for an exchange of filter material, through the back side (60) and that a filter unit (F3) can be removed by an elevation of the legs (63).

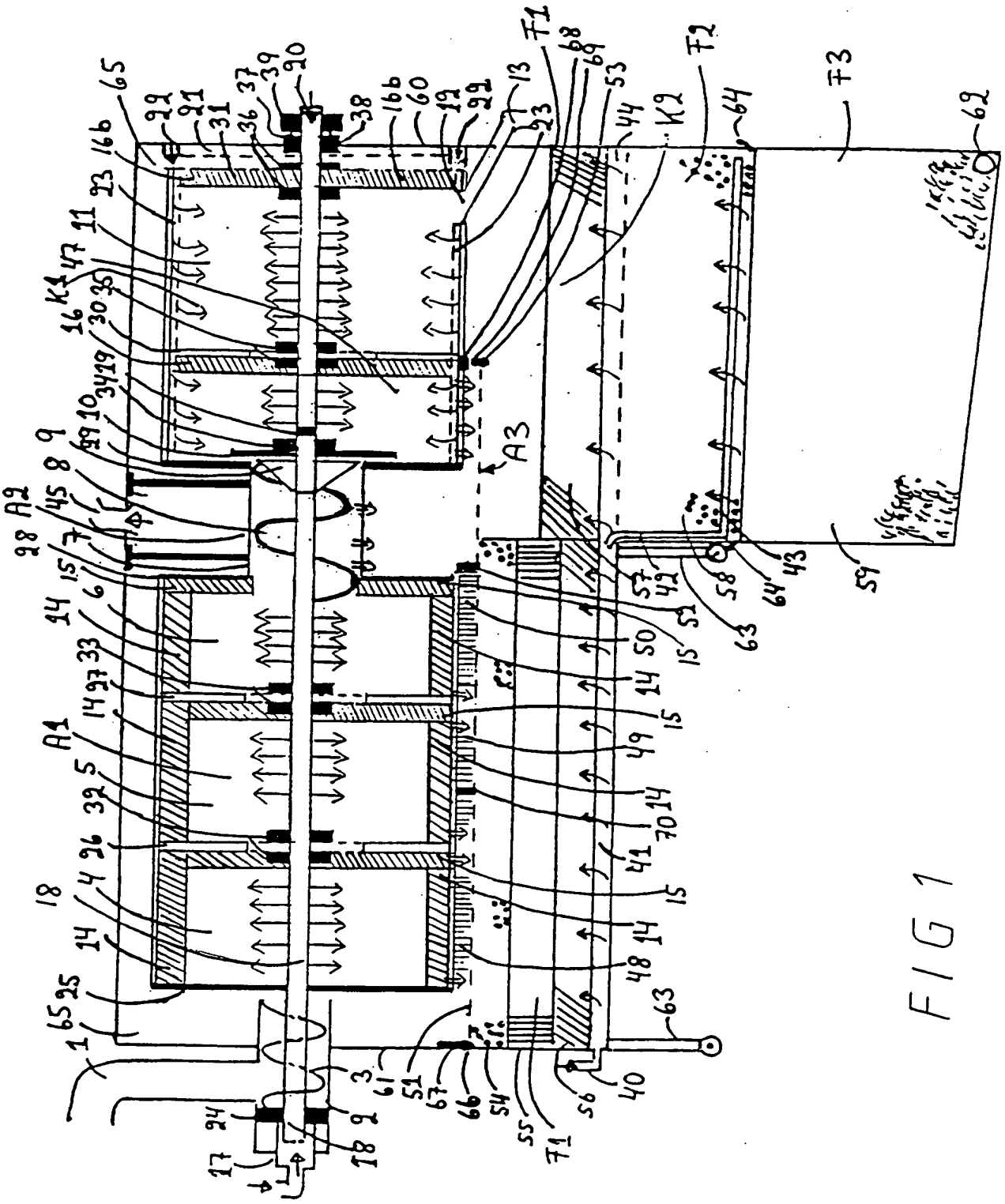

FIG 1

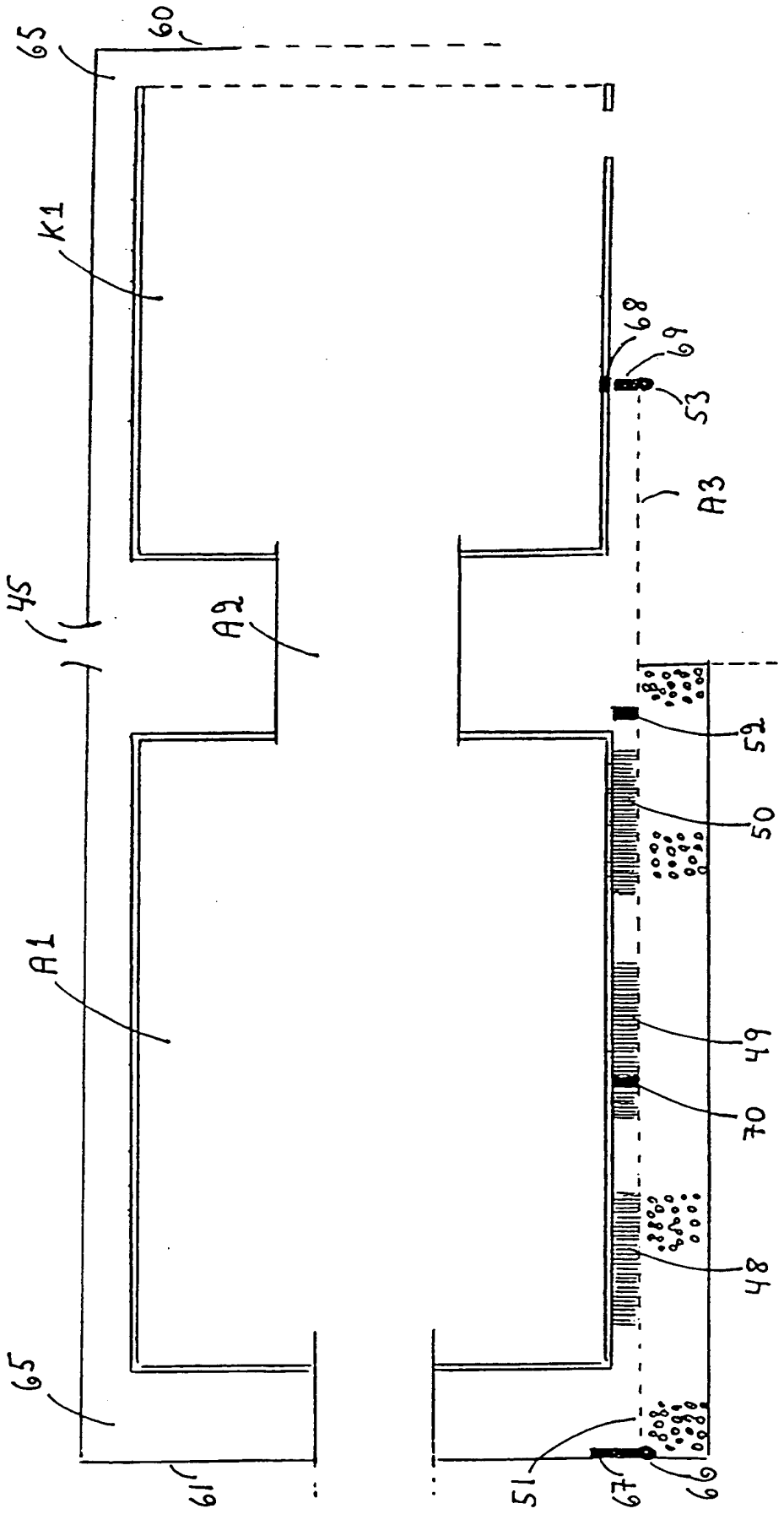

FIG. 2

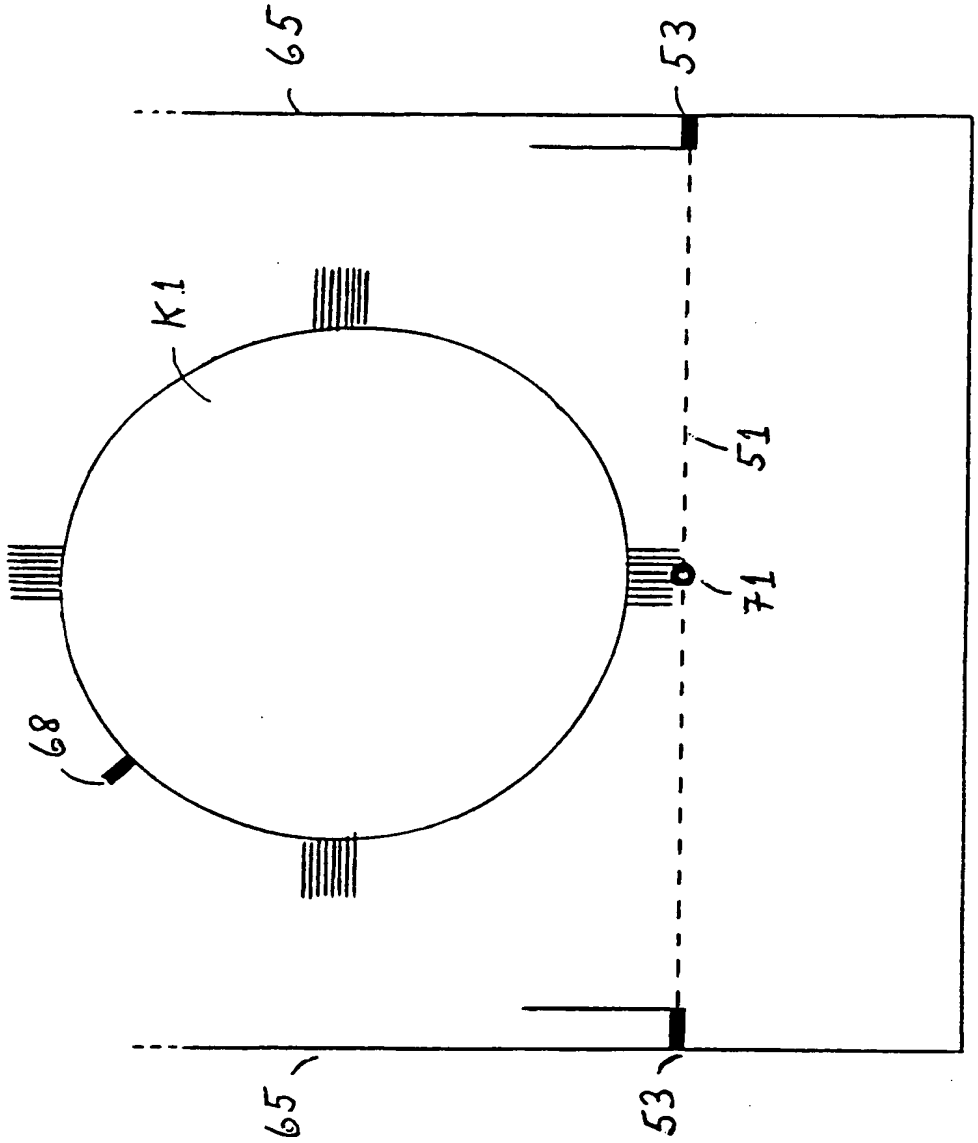

FIG.3

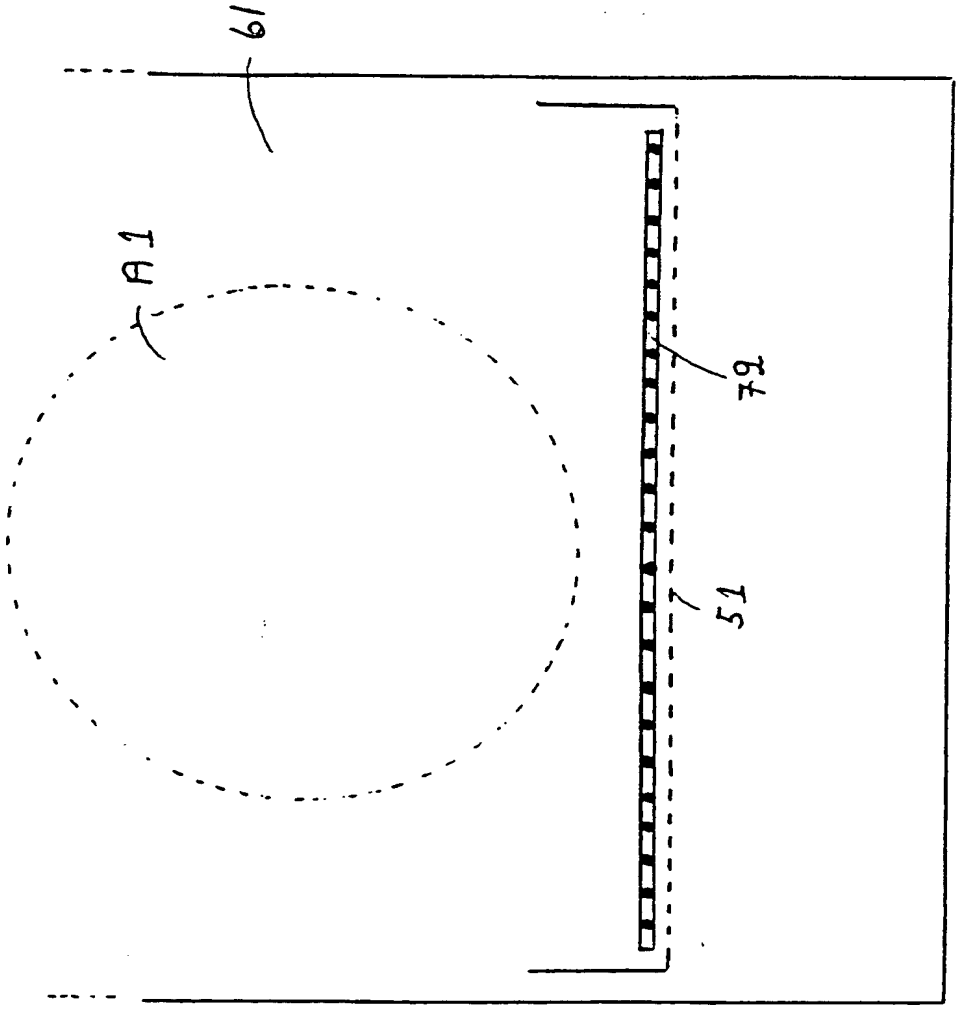

FIG.4

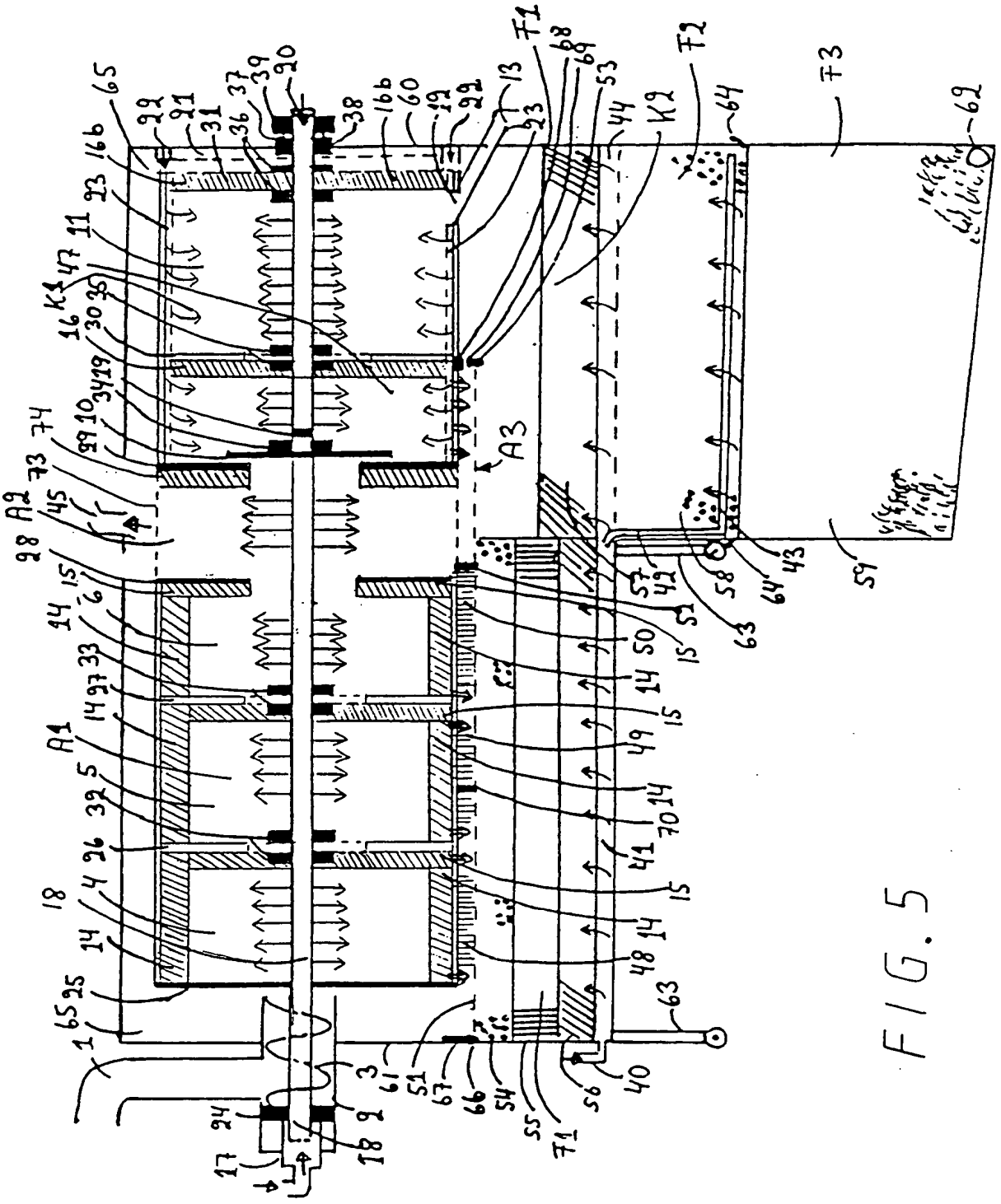

FIG. 5

INTERNATIONAL SEARCH REPORT

Internati nal application No.
PCT/SE 96/00876

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: C02F 1/00, C05F 17/00 // C05F 3/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: C02F, C05F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4196082 A (SALOKANGAS ET AL), 1 April 1980 (01.04.80), figure, abstract --	1-14
A	SE 184706 C (DANO INGENIÖRFORRETNING OG MASKINFABRIK INGENIÖR KAI PETERSEN'S FOND), 20 August 1963 (20.08.63), figure, claim 1 --	1-14
A,P	FR 2727348 A1 (KIM YOUNG TAE ET AL), 31 May 1996 (31.05.96), page 4, line 33 - page 5, line 23 --	1-14
A	US 5296136 A (GUNTHER ABEL), 22 March 1994 (22.03.94), column 1, line 12 - line 28, figures 1, 7 --	1-14

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 November 1996	12 -11- 1996
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Ingela Flink Telephone N . +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 96/00876

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim N .
A	US 5244804 A (HORKAN ET AL), 14 Sept 1993 (14.09.93), figures 1,5, abstract ---	1-14
A	WO 8700073 A1 (INSINÖÖRITOIMISTO LUJARI OY), 15 January 1987 (15.01.87), figure 1, claim 1, abstract -- --------	1-14

INTERNATIONAL SEARCH REPORT

Information on patent family members

28/10/96

International application No.
PCT/SE 96/00876

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		AU-B- 517015	02/07/81
		AU-A- 3932378	06/03/80
		CA-A- 1096063	17/02/81
		DE-A- 2837125	15/03/79
		FR-A,B- 2401878	30/03/79
		GB-A,B- 2003460	14/03/79
		JP-A- 54048964	17/04/79
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		US-A- 5552044	03/09/96
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